IN THE SPECIFICATION

Please amend the following paragraphs as follows:

[0001] Field ~~Filed~~ of the Invention

[0004] In the manufacture of a reliable semiconductor integrated circuit, ~~it is crucial that~~ photolithographic processes having good resolution and a large depth of focus are required to form fine patterns. As more densely packed integrated circuit designs continue to increase, a greater burden is placed on design engineers to improve upon the design of a standard photomask having line patterns with very close spacing between the fine lines, which places added requirements on the photolithographic processing. In addition, whether the component integration of the whole semiconductor industry can continue to advance to further reduce line width to a sub-sub-micron level will also be decided by the technological development of the photolithographic process. In order to meet this demand, processes for increasing photomask resolution, such as the process of optical proximity correction (OPC), are put forward constantly. In regions of the pattern where the spacing between the fine lines is relatively large the use of photomasks using attenuating phase shifting material produces good results. In those regions of the pattern where the spacing between the fine lines is small, however, attenuating phase shifting material will not give good results due to side lobe effect. In the case where a photomask 100 comprising a pattern 102 having parallel lines in predominantly one direction, dipole mode illumination using off axis illumination works well for reliably transferring the pattern 104 onto a layer of a photoresist 180, provided the parallel lines are positioned along a vertical direction that is perpendicular

with respect to a common line 14, of two light exit apertures 12 of a opaque panel 10 of the light projecting system, as illustrated in FIG. 1. However, in case of a photomask 200 comprising a pattern 202 where parallel lines are predominantly along a parallel direction with respect to the common line 24 of two light exit apertures of a opaque panel 20, dipole illumination mode using off axis illumination does not work well, thus the pattern 204 cannot be reliably transferred onto a layer of a photoresist 280, for example due to light scattering and/or interference effects, as illustrated in FIG. 2. Accordingly, in cases where the parallel lines are in more than one direction, for example, if the photomask comprises a plurality of patterns comprising parallel horizontal lines, and parallel vertical lines, then the pattern comprising parallel lines that are positioned predominantly along a vertical direction that is perpendicular with respect to the common line of the dipole mode light exit apertures can be reliably transferred with expected results, whereas, for the pattern comprising parallel lines that are positioned along a parallel direction with respect to the common line of the dipole mode light exit apertures, the pattern cannot be reliably transferred due to, for example, light scattering and/or interference effects. In order to reliably transfer the above pattern on to a photoresist layer, substantially two separate photomasks with one having the parallel horizontal lines, and the second photomask having the parallel vertical lines, and further, two separate exposure steps are required for accomplishing the formation of the above patterns onto a layer of a photoresist, wherein the first exposure is performed by positioning the dipole mode light exit apertures substantially along a direction parallel to the horizontal parallel lines and the second exposure step is

performed by positioning the dipole mode light exit apertures substantially along a direction parallel to the vertical parallel lines. Further, two or more exposure steps could cause defects due overlay problems, which could be of reliability concern. Besides, fabrication cost is substantially increased due to use of an increased number photomasks.

[0007] According to another aspect of the present invention, a photomask with an internal assistant pattern, comprising a first pattern having a plurality of parallel lines along a first direction; a second pattern having a plurality of parallel lines along a second direction, wherein the second direction is different from the first direction; and an internal assistant pattern comprising a plurality of shaped structures formed in at least one of said first or second patterns, is provided. The internal assistant pattern is formed in the first pattern when the parallel lines of the second pattern is positioned parallel with respect to a direction of a common line of light exit apertures of an optical projection system. Further, the internal assistant pattern is formed in the second pattern when the parallel lines of the first pattern is positioned along a vertical direction that is perpendicular with respect to a direction of a common line of light exit apertures of an optical projection system.

[0008] According to another aspect of the present invention, a photomask with an internal assistant pattern, comprising a horizontal pattern having a plurality of horizontal parallel lines; a vertical pattern having a plurality of vertical parallel lines; and an internal assistant pattern comprising a plurality of shaped structures in at least one of said horizontal or vertical patterns, is provided. The internal assistant pattern is

formed in the horizontal pattern when the parallel lines of the vertical pattern are positioned along a vertical direction that is perpendicular with respect to a direction of a common line 24 of light exit apertures of an optical projection system. Further, the internal assistant pattern is formed in the vertical pattern when the parallel lines of the horizontal pattern are positioned along a parallel direction with respect to a direction of a common line 24 of light exit apertures of an optical projection system.

[0013] FIG. 1 illustrates the effect of a dipole illumination mode for forming a parallel lines pattern with parallel lines positioned along a vertical direction that is perpendicular with respect to a common line of two light exit apertures of a light projecting system.

[0019] FIG. 3 illustrates improvement of resolution using the photomask with an internal assistant pattern using a dipole mode off axis illumination according to one preferred embodiment of the present invention. As shown in FIG. 3, a top view of a structure of an opaque panel 30 of in a light projecting system, comprising two light exit apertures 32 positioned along a common line 34; a top view of a segment of a photomask 300 comprising a plurality of patterns 302 and 352. The pattern 302 comprises a plurality of parallel lines extending along a vertical direction that is perpendicular with respect to the common line 34, and the pattern 352 comprises a plurality of parallel lines extending along a direction parallel with respect to the common line 34. An internal assistant pattern 500 of the present invention is included within the pattern 352.

[0021] When the photomask 300 of the present is exposed through the light exit

apertures 32, since the parallel lines of the pattern 302 are positioned along a vertical direction that is perpendicular with respect to the common line 34 of the light exit apertures 32, therefore, the pattern 302 can be reliably transferred as a pattern 304 onto a layer of a photoresist 380 as shown in FIG. 3. Further, even though the parallel lines of the pattern 352 are positioned along a parallel direction with respect to the common line 34, because the internal assistant pattern 500 is disposed within the pattern 352, the phenomenon of critical dimension (CD) bias caused by proximity effect due to, for example, light scattering and/or interference effects, can be effectively reduced or eliminated. Thus the optical resolution can be effectively enhanced. Accordingly, the pattern 352 can be reliably transferred as pattern 354 onto the layer of the photoresist 380 as shown in FIG. 3.

[0023] Even though the present invention is described using a photomask comprising two patterns, with one pattern having parallel lines substantially extending along a vertical direction that is perpendicular with respect to the parallel line of the second pattern, however, it is to be understood that more than two patterns may be formed on the same photomask, and that the direction parallel lines can be at any angle with respect to the common line of the two light exit apertures, and that most importantly though that the internal assistant features is included within those patterns comprising parallel lines that extend substantially in a direction different compared to the common line of the two light exit apertures, in order to practice the present invention. Thus, this makes it possible to form a plurality patterns with parallel lines extending in more than one direction on the same photomask so that a multi-dimensional pattern can be

reliably transferred onto a layer of a photoresist by using a single photomask through a single exposure step. Thus, the number of photomask in a semiconductor processing can be effectively reduced so that the processing cost can be effectively reduced. Further, this would substantially reduce defects, for example, overlay defects, due to multiple exposures.